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CONDITIONS AND POSSIBILITIES OF USING E-LOGISTICS IN MANUFACTURING ENTERPRISES

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ABSTRACT: Progressing globalisation, competitiveness and implemented technological innovations constitute important challenges for enterprises operating in such a turbulent environment. Organisations are forced to adapt much faster and more flexibly to rapidly changing market conditions. Manufacturing companies realise that it is impossible to meet market requirements by constantly using conventional methods of operation, especially in the sphere of physical flows of goods, information and financial resources, for which logistics is responsible. One of the solutions that can support manufacturing companies is e-logistics, which enriches logistics phases and processes in the sphere of information technology (IT) and information and communication technologies (ICT). The aim of the study is to identify the conditions and possibilities of using e-logistics in Polish manufacturing enterprises.

KEYWORDS: e-logistics, logistics management, manufacturing enterprises

Introduction

Competitiveness is a feature that means the ability to achieve the goals set by the organisation. Strong pressure from consumers, investors and the companies supervising them has a significant impact on the implementation of actions and solutions that take into account economic, environmental and social aspects at the same time. One of the conditions for manufacturing companies to achieve their goals is the efficiency and effectiveness of logistics processes, which, supported by ICT technologies and automation, can increase their effectiveness. The combination of information technologies with logistics processes is referred to in the literature as e-logistics (e-logistics processes). In the presented study, it was decided to look at the issues of e-logistics in the example of Polish manufacturing enterprises. In order to identify the conditions and possibilities of using e-logistics in Polish manufacturing enterprises and to maintain the epistemological structure of the presented study, it was decided to divide the article into the following stages (Wierzeczycki, 2012):

- defining the concept of e-logistics,
- conducting a literature review using bibliometric and abstract databases, allowing for the identification of research gaps,
- formulating research questions,
- defining the main goal and specific goals of the article,
- describing the assumptions of the article,
- presentation of the research method,
- presentation of research results,
- discussion.

The concept of e-logistics is defined by authors in various ways. Szymanik claims that e-logistics is primarily the use of the latest ICT technologies whose task is to support logistics management in enterprises, and the most frequently supported processes are production processes, warehouse management and order fulfilment (Szymanik, 2016). Reviewing the bibliometric and abstract databases Scopus (Scp) and Web of Science (WoS) for the concept of e-logistics, some of the first publications on this topic date back to 2000.

In 2003, Oh and co-authors published a conference paper on an e-logistics platform with business process automation components (Oh et al., 2003). In the same year, Kim and co-authors described a relational model of moving objects and design supporting e-logistics applications (Kim et al., 2002). Analysing the selected definitions of e-logistics, it can be noticed that they show some diversity. Zunder and Islam say that e-logistics is a new terminology for information and technology (ICT) in logistics processes and supply chains (Zunder & Islam, 2011). In turn, Burak presents e-logistics as a dynamic set of communication technologies (IT, ICT), information technologies (Big Data Analysis – BDA, Cloud Computing – CC) and cooperative technologies that help in making effective decisions (Burak, 2022). According to Alt and Zbornik, physical logistics refers to the flow of products that ultimately ends in delivery. It includes the selection of a carrier, tracking the shipment in transit and the transportation itself. The authors defined the use of Internet technologies to support these activities as e-logistics (Alt & Zbornik, 2003).

Therefore, the presented definitions clearly emphasise the interpretation of e-logistics as the implementation of logistics processes (transport, storage, packaging, order fulfilment and inventory management) supported by information and communication technologies and automation. This is also confirmed by the definition from the online dictionary, where e-logistics is defined as a field of logistics knowledge involving the use of the Internet and IT systems for cooperation and integration in supply chains and networks. All necessary information about the product is sent between chain participants, and the product goes directly to the customer, bypassing warehouses, reloading places, wholesalers and distributors. E-logistics service providers may be traditional logistics companies and electronic markets enabling the sale and purchase of logistics, forwarding and transport services via the Internet (Olszański & Piech, 2012).

Beier and Rutkowski point out that the concepts of e-logistics and e-business are closely related. Both of them use modern ICT technologies to carry out their tasks and have a certain set of processes consistent with both of them, which include (Beier & Rutkowski, 2004):

- promotion (of offered products and services),

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- negotiations aimed at finding business partners, establishing the most favourable terms of cooperation with them, and thus including them in the company's supply chains (delivery and distribution),
- handling the cycle of placing and fulfilling orders,
- payments for completed or accepted orders,
- providing appropriate products and expected services.

Rutkowski also indicated the 10 most important functions that e-logistics performs in an organisation. It included (Rutkowski, 2002):

- collecting information about the demand for materials needed for the operation of the enterprise (e.g. raw materials for production, but also office supplies),
- supervision of inventory levels,
- ensuring proper distribution of the finished product to the intermediary or end customer,
- support for just-in-time (JIT) planning and delivery processes,
- tracking the goods from the moment they leave the warehouse until they reach the indicated place,
- facilitating order fulfilment processes,
- facilitating decision-making about promotions, price reductions and sales,
- controlling payment statuses for orders,
- support in contacts and negotiations with business partners,
- quick implementation of new employees.

Sułkowski and Morawski noted that e-logistics, like e-business, use tools such as Internet portals, electronic (internet) platforms, electronic catalogues, electronic repositories, data warehouses, information services, offer systems and purchasing, transaction systems, communication systems and tools, specialist systems and software: including supply chain planning applications, dictionaries, digital maps, e-learning systems, online banking systems (Sułkowski & Morawski, 2012).

Andrzejczak also draws attention to e-logistics tools. He notes that e-logistics in the enterprise is constantly changing. Maximises the use of IT systems and technological innovations. The tools for the development of logistics and e-logistics include electronic document circulation (transport documents, delivery notes, invoices), electronic integration of transmitted documents – thanks to modern technologies; all documents are delivered immediately, the use of all modern technologies in logistics (integrated IT systems supporting logistics management), unification and automation of logistics processes – thanks to this process, costs in the company are reduced (Andrzejczak, 2013).

In turn, Niżyński and his co-authors point out that e-logistics in an enterprise improves the flow of information between producers, suppliers and customers, which contributes to shortening the supply chain and, consequently, accelerating the implementation of intended plans and profits. The authors list the main advantages of e-logistics (Niżyński et al., 2011):

- time compression,
- reduction of logistics costs,
- freeing yourself from geographical distances,
- automatic response to signals received from the market, potentially initiating logistics processes,
- shortening supply chains,
- effective market research.

Dynamically developing modern technologies support logistics processes in shaping e-logistics. Enterprises are interested in technological innovations that allow for a quick return on invested capital. E-logistics may be the future of enterprises, which is why so many organisations are introducing new e-solutions to maximise profits.

By reviewing the literature of the Scopus and Web of Science databases for research conducted in the area of e-logistics, a query was formulated to find all articles containing the word e-logistics in the title. In the case of the Scopus database, 99 literature items were identified, of which just over 20% were assigned to thematic areas related to computer science and engineering. Less than 15% of the publications came from the area of Business, Management and Accounting – Figure 1.

By narrowing down the reviewed publications only to areas related to management and economics (disciplines related to the authors scientific interests), it was decided to review the titles, abstracts and content in terms of research conducted in the area of e-logistics. Of the 26 documents analysed, a large part of the content is devoted to customer satisfaction issues, including publications by Imran

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and co-authors (Imran et al., 2019). However, from the point of view of the presented topic, the authors attention was attracted by 4 articles showing current directions of research in logistics.

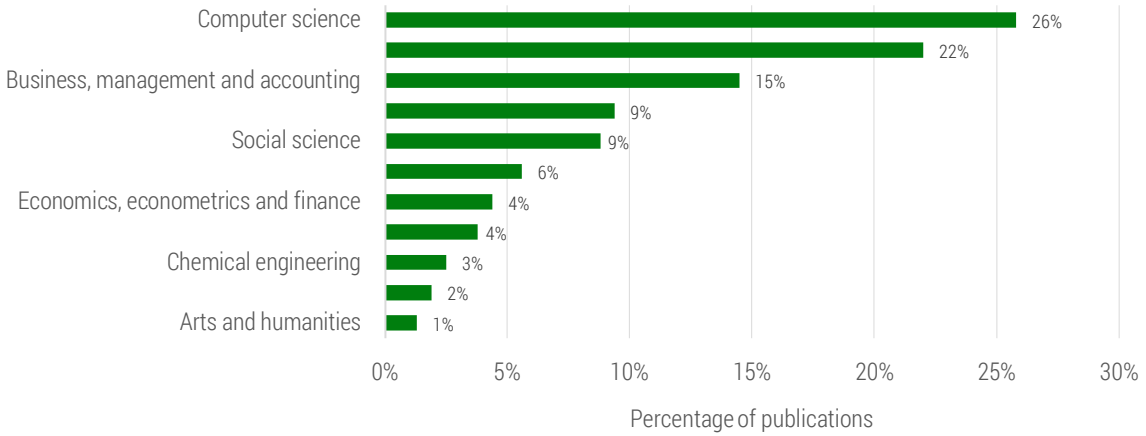

Figure 1. Percentage of publications with the word "e-logistics" in the title according to Subject Area of the Scopus database

Source: authors' work based on Scopus database analytical tools.

The first one, developed by Qurtubi et al. (2021) described the development of research on e-logistics. The authors analysed 21 scientific articles available online in five publication databases. Of the analysed articles, most of them were concerned with the implementation and consequences of the implementation of e-logistics, while the rest were concerned with the concept, model and the e-logistics system itself. It should be noted that the research topic of e-logistics did not refer to its conditions and possibilities of use.

Erceg and Sekuloska, in turn, dealt with the issue of competitiveness of e-logistics and e-supply chains. The authors drew attention to the issue of cooperation between enterprises, including logistics service providers within the supply chain, using e-logistics tools to improve competitiveness (Erceg & Sekuloska, 2019).

The third article referred to the e-logistics model in small and medium-sized enterprises (Inayatulloh, 2021). The author identified the key aspects of the logistics of small and medium-sized enterprises and, on this basis, through a systematic review of the literature, determined the key aspects of the logistics of small and medium-sized enterprises. In the case of this article, there is no division of enterprises according to production and service activities (production enterprises, service enterprises, trading enterprises, etc.).

The publications also include those that link e-logistics with the natural environment. Already in 2004, Sarkis and his co-authors drew attention to the issue of the impact of electronic logistics on the environment, pointing out the need to address the issue of reverse e-logistics (Sarkis et al., 2017).

The Web of Science bibliometric and abstract database identified 67 publications containing the phrase "e-logistics" in the title. In this case, it should be noted that publications in the areas of management, business and IT dominate – Figure 2.

By separating the WoS Management, Business, and Economy categories, the database identified 26 literature items, several of which were duplicates of items previously identified in the Scopus database. In this case, the authors decided that 3 items may constitute an interesting contribution to research on e-logistics in the context of the presented topic. Similarly, to the Scopus database, several articles relating to customer satisfaction (Davidaviciene & Meidute, 2011) and the quality of e-logistics services were identified (Ta et al., 2023).

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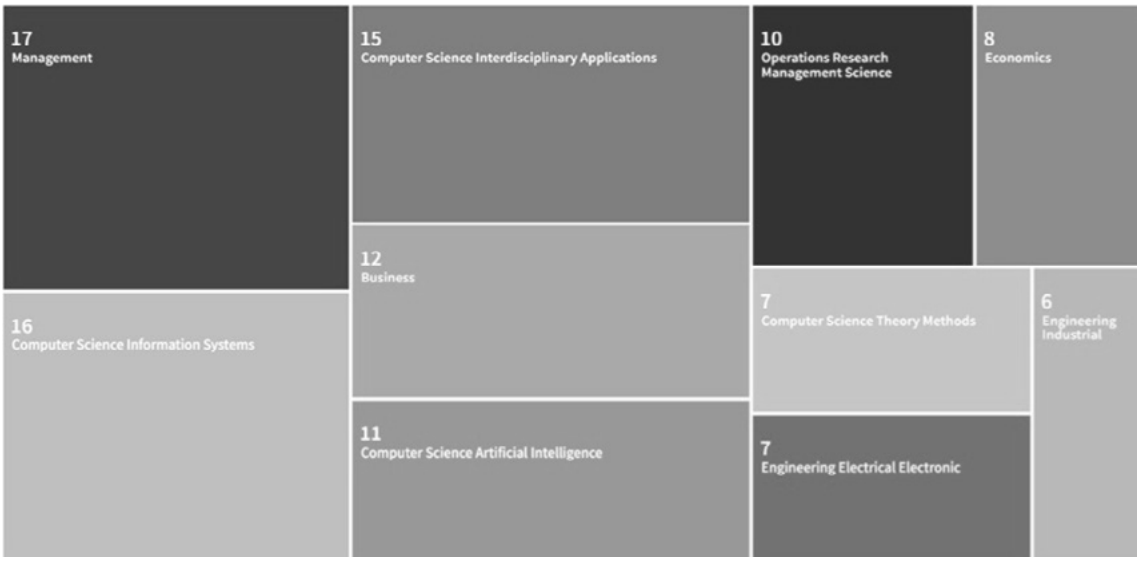

Figure 2. The numerical share of publications with the word "e-logistics" in the title according to Web of Science Categories

Source: authors' work based on analytical tools of the Web of Science database.

The first of the publications selected by the authors concerns research on the structure of e-logistics information systems. Wang presented various variants of IT systems supporting e-logistics (Wang, 2009). In turn, Chen and co-authors presented research on e-logistics in the context of transport processes (Chen et al., 2022), and Nadeem and co-authors presented key indicators and measures of e-logistics systems, emphasising the dominant role of ICT technologies (Nadeem et al., 2018).

The literature review conducted by the authors of the presented article indicates that the publications did not present research similar to the topics discussed in the study. In this way, a research gap was identified that justifies undertaking scientific work on the conditions and possibilities of using e-logistics in Polish manufacturing enterprises.

The problem presented in this way allows us to formulate the following research questions:

- How is e-logistics perceived by enterprise employees?
- What tools are used in enterprises in the context of e-logistics?
- What are the effects of using e-logistics in an enterprise?

The answers to these research questions allow us to define the purpose of the work, which is to identify the conditions and possibilities of using e-logistics in Polish manufacturing enterprises. The formulated main goal of the work sets out specific goals, which include:

- performing a literature review,
- development of a research method,
- testing,
- analysis of research results and recommendations.

The presented main goal and detailed goals allowed the authors to formulate research assumptions (which had a direct impact on the research method). As part of the research, the authors decided to use quantitative and qualitative methods that allowed them to identify the conditions for the functioning of e-logistics in production enterprises in terms of the technologies used and the expected effects. This allowed us to simultaneously identify the possibilities of using e-logistics in the examined enterprise and obtaining data enabling the assessment of employees' awareness in the context of e-logistics.

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Materials and Methods

The research method is a diagnostic survey, the technique is a survey, and the tool is a survey questionnaire. The diagnostic survey method is a way of collecting knowledge about structural and functional features, as well as the dynamics of social phenomena, views and opinions of selected populations and directions of development of specific phenomena (Aponowicz, 2015).

To answer the research questions posed above, it was decided to prepare a survey questionnaire consisting of four basic parts:

- respondents data (age, education, place of residence, professional status, length of service, job position),
- e-logistics tools used in the company,
- employees knowledge of e-logistics issues (knowledge of issues related to logistics, e-logistics, tools for carrying out e-logistics tasks),
- employees opinions on the effects of using e-logistics (the role of e-logistics, advantages and disadvantages of e-logistics).

The study was conducted in the second quarter of 2021. The research framework was a group of 135 employees of EPC Projekt Spółka Akcyjna based in Piotrków Trybunalski, Poland. EPC Projekt S.A. offers its clients not only the construction of steel structures but also the production, assembly, and commissioning of complex devices and machines. It is worth adding here that the company most often implements its projects based on independently prepared technical documentation. 104 respondents took part in the empirical study, which constitutes 77% of the surveyed population, which allows the sample to be considered representative of the company under study. Participation in the study was voluntary and anonymous. The selection of the sample was purposeful. Before completing the surveys, respondents were informed about the purpose of the study and instructed on how to properly complete the survey, which enabled precise preparation of the results, which are presented in a descriptive form later in the article. The survey questionnaire consisted of 23 questions, most of them could only be answered once, and all surveys were completed correctly.

Results

Analysing the details of the study, it can be concluded that among the 104 people included in the study, there were 52 men and 52 women. Half of them were born between 1992 and 2003 – so they range in age from 29 to 18. These are young people who have just started working. Almost half of the respondents were people born between 1967 and 1991. The fewest people, only 4% of respondents, were over 55 years of age.

The majority of respondents, as many as 62%, live in the city. The remaining part, i.e. 38% (40 people), live in the countryside. There were no people with primary or basic vocational education among the respondents. The majority completed college – 69%, and 31% completed secondary school. Only 8% of the population are blue-collar workers, which with about 73% of office workers is quite a big difference. This is due to the specific nature of the company, which also has design and development processes. 12% of respondents declared that they were still studying (students), and the rest were connected with the company through other legal forms. The study did not include unemployed people, freelancers and retirees.

The majority of respondents – 31% of respondents- were management staff. 19% of respondents were administrative employees. 15% of people work in production and 12% in the purchasing department. Respondents also included employees of the financial department and marketing department. The study did not include an employee of the occupational health and safety department or the design department. Most respondents are young people who have recently become professionally active. 42% of respondents work for a year or longer, up to 5 years. 31% have been employed for 6 to 10 years. About 23% of respondents have been working for the company for more than 10 years. However, only 4% of respondents have been working for less than a year.

When analysing e-logistics tools, the vast majority of respondents had heard of this concept (66%). About 33% of surveyed employees declared that they did not know this concept. According to

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respondents, the most popular information technologies used in logistics are barcodes, as shown in Figure 3.

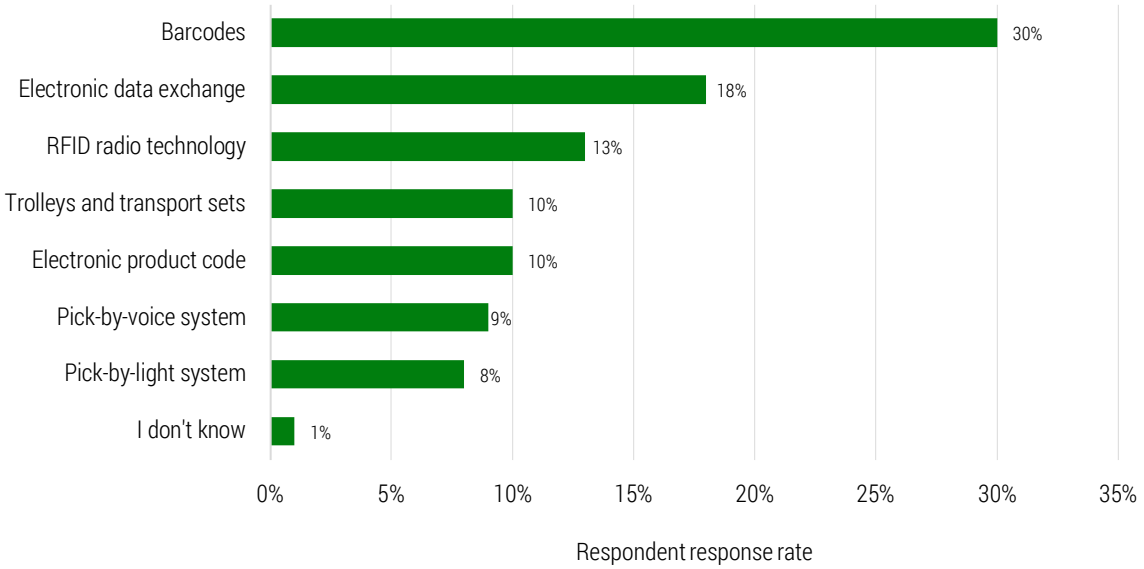

Figure 3. Knowledge of logistics technologies

Source: authors' work based on research results.

Electronic data exchange, radio frequency identification (RFID), electronic product codes and Pick-by-Voice and Pick-by-Light systems are also very popular among the surveyed employees. Among the hard technologies used in e-logistics, respondents indicated trolleys and transport sets.

According to respondents, the most popular tools for implementing e-logistics tasks are internet portals (13% of responses), supply chain planning applications (12%), communication systems and tools (12%), and offer and purchasing systems (11%). E-learning and banking systems and electronic repositories are moderately known. 1% of respondents did not know any of the mentioned tools – Figure 4.

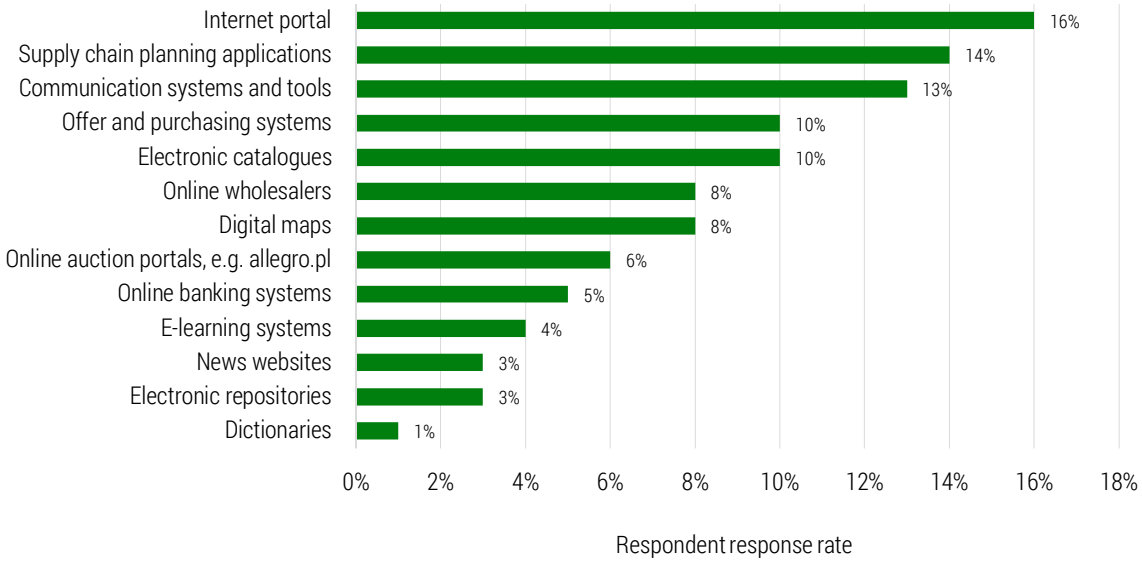

Figure 4. The most frequently used tools in e-logistics

Source: authors' work based on research results.

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Among the most popular IT systems related to e-logistics, respondents indicated CRM and ERP systems (approximately 28% of responses each). Next, respondents paid attention to supply chain management systems (25%) and warehouse management (17%).

Analysing employees knowledge of e-logistics, the majority of respondents (54%) believe that e-logistics is a field of logistics involving the use of the Internet and information systems to coordinate and integrate activities leading to the delivery of products from producers to retailers or consumers. 27% of people said that it is the process of planning, implementing and controlling the efficient and economically efficient flow of raw materials, semi-finished products and finished products, together with information related to these flows from the point of consumption to the places of origin in order to recover value or appropriate management. A similar number of respondents believe that e-logistics is a logistics system linked to the market (it is a link between the distribution logistics of suppliers and the logistics of production in the enterprise). None of the respondents indicated e-logistics understood as a logistics system related to the market, linking the distribution logistics of suppliers with the logistics of production in the enterprise, or considering that e-logistics deals with the management of logistics processes in an urban environment.

Referring to employees opinions on the use of e-logistics, according to 39% of respondents, the greatest advantage of using e-logistics in the company is the reduction of logistics costs. The remaining variants (apart from effective market research) were chosen by the same percentage of respondents. 19% of respondents consider time compression, lack of geographical distances and shortening of the supply chain to be advantages – Figure 5.

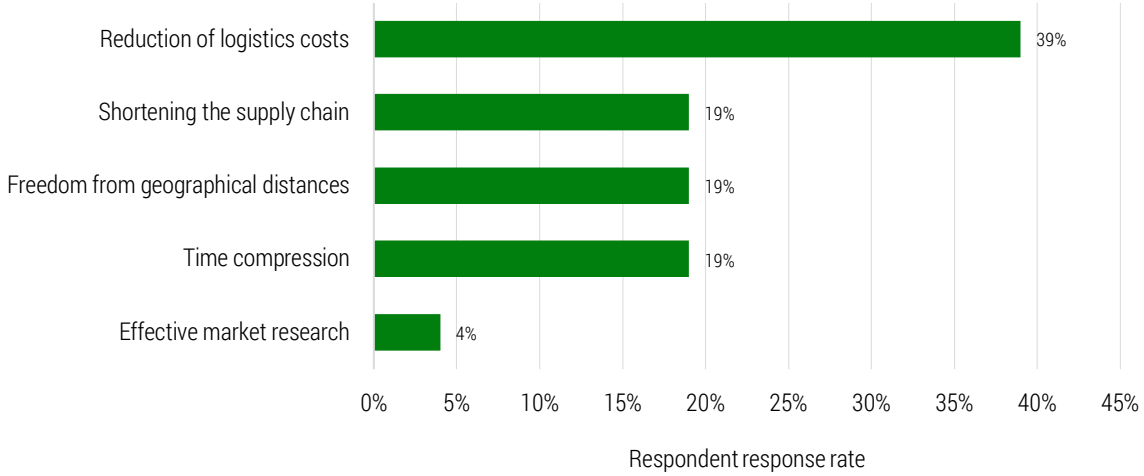

Figure 5. Advantages of e-logistics according to respondents

Source: authors' work based on research results.

Almost half of people (46%) believe that the biggest disadvantage of e-logistics is the lack of experience of its users. According to 1/3, the disadvantages include high initial costs. 19% of respondents also consider costs to be a disadvantage, not the initial costs, but the monthly service costs.

About 30% of respondents believe that expanding knowledge in the field of e-logistics may have an impact on replacing human work with robots. On the other hand, the same percentage of respondents have the opposite opinion. Among the respondents, over 40% believe that e-logistics solutions are not used in their workplace. However, 39% know that such solutions are used in their workplace. About 20% of respondents were unable to answer this question. According to most people, e-logistics plays a large or even very large role in an enterprise. Only two people say her role is average. According to the majority, e-logistics has significantly improved work in logistics processes. 64% of respondents want e-logistics systems to be implemented in their workplace, and 27% believe that it is unnecessary. About 9% have no opinion on this issue.

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Discussion

Against the background of research conducted to determine the conditions and functioning of e-logistics in Polish manufacturing enterprises, it can be noted that e-logistics is a recognisable concept in the studied enterprise. It should be noted that the study involved young, educated people with short professional experience, which may certainly influence the answers obtained. Despite this, most respondents point to IT tools supporting logistics, and they are familiar with the concept of e-logistics.

It can also be noted that in the era of the fourth industrial revolution, the concept of e-logistics is gradually being devalued. I am definitely closer to computerisation and automation, which are representatives of the third industrial revolution, than to solutions such as the Internet of Things, cyber-physical systems or the analysis of large data sets.

This does not change the fact that in the surveyed company, respondents assessed solutions related to e-logistics rather positively. Respondents note that this is an opportunity to develop the company and maintain a leading position in the market. The conducted research emphasises the importance of e-logistics as a management tool in the enterprise. It is also important that people participating in the study are able to describe not only the advantages of using selected e-logistics tools but also indicate its disadvantages.

The presented research results may become a good starting point for an academic discussion on e-logistics, its concept, essence and increasingly broader scope. Moreover, they can help describe the relationship between e-logistics and the latest Industry 4.0 technologies.

Based on the presented research, the following conclusions can be drawn:

- most respondents know the concept of e-logistics,
- people who answered the survey questions know different types of IT systems related to e-logistics,
- each respondent knows any tool for carrying out tasks in the field of e-logistics and logistics technologies,
- respondents are able to list both the advantages and disadvantages of e-logistics,
- half of the respondents noticed the e-logistics solutions used in the company,
- there is a group of employees who, in their opinion, do not use e-logistics solutions in the company and would like to change that.

The results presented in the research may be a good start in the process of expanding them. However, it seems that the key element is to determine the relationship between e-logistics and the I4.0 concept.

Conclusions

A dynamically changing economy operates in conditions of volatility, uncertainty, ambiguity and complexity (VUCA world). Enterprises that want to achieve their goals must constantly be aware of global changes taking place in the market, where logistics plays an important role. This certainly increases the popularity of the use of ICT tools in logistics.

Modern information technologies used in logistics management are becoming everyday life. They help in the efficient functioning of enterprises, facilitating the organisation and work of the entire company. They improve, among others, the ordering process, warehouse management, the production process or the administration itself. Enterprises using e-logistics in their operations significantly improve the management process of not only one or two departments but the entire unit. This allows you to strengthen your position among your competitors.

Modern enterprises using e-logistics solutions use modern hardware and organisational technologies. Advanced modern technologies mean greater opportunities for the development and operational activities of enterprises. Considerations of e-logistics as a contemporary form of business management are, therefore, quite important from the point of view of enterprises.

It should be noted, however, that e-logistics in the era of the development of Industry 4.0 technology can only be an intermediate point – a link connecting the second and fourth industrial revolutions. It should remain a tool for optimising logistics processes for some time for those enterprises

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for which the vision of development under the I4.0 concept has been postponed until a little later. It is, therefore, necessary to examine the relationship between e-logistics and the I4.0 concept, as it may turn out that future research directions will be logistics and supply chains 4.0 (closed-loop logistics and supply chains).

The contribution of the authors

Establishing the concept, D.T. and M.B.; establishing research methods, D.T. and M.B.; creating text, D.T. and M.B.; analytical description of the phenomenon, D.T.; implementation of the research idea, D.T. and M.B.; critical assessment, D.T.; data collection, D.T. and M.B.; data analysis and interpretation, D.T. and M.B.; development of research results, D.T. and M.B.; review of the literature, D.T. and M.B.

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UWARUNKOWANIA I MOŻLIWOŚCI WYKORZYSTANIA E-LOGISTYKI W PRZEDSIĘBIORSTWACH PRODUKCYJNYCH

STRESZCZENIE: Postępująca globalizacja, konkurencyjność oraz wdrażane innowacje technologiczne stanowią ważne wyzwania przed przedsiębiorstwami funkcjonującymi w tak turbulentnym otoczeniu. Organizacje są zmuszone znacznie szybciej i elastyczniej dostosowywać się do gwałtownie zmieniających się warunków rynkowych. Przedsiębiorstwa produkcyjne zdają sobie sprawę, że nie da się sprostać wymaganiom rynku stosując cały czas, konwencjonalne sposoby działania, szczególnie w sferze fizycznych przepływów dóbr, informacji i środków finansowych za które odpowiedzialna jest logistyka. Jednym z rozwiązań, którym mogą wspomagać przedsiębiorstwa produkcyjne jest e-logistyka, która wzbogaca fazy i procesy logistyczne o sferę technologii informatycznych (IT) oraz informatyczno-komunikacyjnych (ICT). Celem opracowania jest identyfikacja uwarunkowań i możliwości wykorzystania e-logistyki w polskich przedsiębiorstwach produkcyjnych.

SŁOWA KLUCZOWE: e-logistyka, przedsiębiorstwa produkcyjne, zarządzanie logistyczne

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